An Evaluation of the Impact of Maternity Care Coordination on Medicaid Birth Outcomes in North Carolina

ABSTRACT

Background. Care coordination is an important component of the enhanced prenatal care services provided under the recent expansions of the Medicaid program. The effect of maternity care coordination services on birth outcomes in North Carolina was assessed by comparing women on Medicaid who did and did not receive these services.

Methods. Health program data files, including Medicaid claims paid for maternity care coordination, were linked to 1988 and 1989 live birth certificates. Simple comparisons of percentages and rates were supplemented by a logistic regression analysis.

Results. Among women on Medicaid who did not receive maternity care coordination services, the low birth weight rate was 21% higher, the very low birth weight rate was 62% higher, and the infant mortality rate was 23% higher than among women on Medicaid who did receive such services. It was estimated that, for each $1.00 spent on maternity care coordination, Medicaid saved $2.02 in medical costs for newborns up to 60 days of age. Among the women who did receive maternity care coordination, those receiving it for 3 or more months had better outcomes than those receiving it for less than 3 months.

Conclusions. These results suggest that maternity care coordination can be effective in reducing low birth weight, infant mortality, and newborn medical care costs among babies born to women in poverty. (*Am J Public Health.* 1991;81:1625–1629)

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Introduction

Factors associated with infant mortality and morbidity and with handicapping conditions in infants and young children are numerous and complex. It has been documented repeatedly, however, that the single most important factor contributing to infant death and disability is low birth weight.[1,2] Avoiding unintended and high-risk pregnancies is an important first line of prevention.[3] Experience proves that the incidence of low birth weight can also be reduced through the use of early, continuous, and comprehensive prenatal care.[4]

In October 1987, in response to concerns over North Carolina's high infant mortality rate, the state Medicaid program was expanded to improve access to health care and support services for low-income pregnant women and young children. This expansion, referred to in North Carolina as the Baby Love Program, was developed and implemented by the Division of Maternal and Child Health and the Division of Medical Assistance, in cooperation with the Office of Rural Health and Resource Development. Two key elements of the Baby Love Program were expansion of Medicaid eligibility to 100% of the federal poverty level and reimbursement for maternity care coordination (case management) services for Medicaid-eligible pregnant women.

Maternity care coordination is the cornerstone of the Baby Love Program in that it is aimed directly at eliminating barriers to client use of services. Maternity care coordinators help eligible women receive services that address not only medical but also nutritional, psychosocial, and resource needs. Coordinators also provide pregnant women with social and emotional support, which may lead to stress reduction and the adoption of healthful behaviors during pregnancy. In North Carolina, all pregnant women certified for Medicaid are eligible for maternity care coordination services. This entire population is considered to be at high risk for poor pregnancy outcomes, owing to either medical or psychosocial risk factors, or a combination of the two.

Previous studies have shown that comprehensive prenatal care, which includes various nonmedical support services, improves birth outcomes among women in poverty.[4,5] The purpose of this evaluation is to determine if the receipt of maternity care coordination services by Medicaid-eligible clients improves birth outcomes. Maternity care coordination, which began in late 1987, was introduced as a statewide program. Because the program was not piloted in a limited geographic area of the state, it was important to conduct the evaluation before the statewide system was fully developed to ensure that a comparison group of nonrecipients could be obtained.

The period of evaluation was 1988 and 1989, the first 2 years of program im-

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plementation. During this time, more than 15 000 women received maternity care coordination, two thirds of whom were served in 1989. For the 2-year period, the mean month of pregnancy in which maternity care coordination began was 5.6. In 1988, the start-up year, the mean month of service initiation was 6.0; in 1989, this had improved to 5.4.

Methods

North Carolina resident live births to women on Medicaid during calendar years 1988 and 1989 were examined to compare birth outcomes of those women who received maternity care coordination services with the outcomes of those who did not. The birth outcomes compared were low birth weight (less than 2500 g), very low birth weight (less than 1500 g), infant mortality, and newborn medical care costs (which are, to some degree, a surrogate for infant morbidity). The effect of maternity care coordination on prenatal participation in the Special Supplemental Food Program for Women, Infants and Children (WIC) was also examined.

To carry out this evaluation, we linked a number of data files to 1988 and 1989 birth certificate records. Using the baby's name, date of birth, hospital of birth, and other information, we matched birth records to newborn hospital claims paid by Medicaid to identify "Medicaid" births and achieved a matching rate of over 95%. Then, using the baby's Medicaid ID number retained from this step, we extracted all claims paid for any service (inpatient, outpatient, medications, etc.) *beginning* within 60 days of birth and we summarized the costs. If a hospitalization began within 60 days of age but extended beyond that time all costs for the hospitalization were counted. These costs were examined only for services beginning within 60 days of birth because maternity care coordination would be expected to have its major impact on early infant morbidity. Also, the babies of women receiving maternity care coordination are automatically eligible to remain on Medicaid for 60 days after birth; thus, there is no problem of attrition within this group due to discontinued eligibility.

Using the mother's name and date of birth, we matched birth records to claims paid for maternity care coordination to identify births for which the service was received. Total amount paid for care coordination was retained from this step. Then we summarized prenatal visit records from the public health department client information system in North Carolina and, again using mother's name and date of birth, matched them to the birth records to identify those births that received prenatal clinic care in health departments. And we used mother's name and date of birth to match births with WIC records to identify women receiving this nutritional service during the prenatal period. Finally, infant death records were linked to the 1988 and 1989 birth cohorts as part of routine vital records processing, and this allowed us to assess infant mortality rates.

In matching the maternity care coordination, health department, and WIC records to the 1988 and 1989 births, we achieved a matching rate of about 90%. Incomplete matching of the maternity care coordination records has resulted in some maternity care coordination recipients being counted as nonrecipients. To the extent that maternity care coordination does improve birth outcomes, this incomplete matching has caused the findings shown here to understate the true difference between the two groups.

Within the group of Medicaid births identified by a matching Medicaid newborn hospital claim, we compared birth outcomes between women with and without maternity care coordination. Multiple births (twins etc.) and births with no prenatal care, the latter of which would all fall into the not-care-coordinated group and thus bias the results, were excluded from the analysis to increase the validity of the comparisons. Simple comparisons of percentages and rates were supplemented by a logistic regression analysis. This analysis assessed the effect of maternity care coordination on birth outcomes while statistically controlling for differences between the two groups on other measurable risk factors.

We also compared outcomes for women on Medicaid with different lengths of maternity care coordination, as defined by months of participation (less than 3 months vs 3 months or more). Because there could be some bias in the results by length of participation, given that a woman who delivers prematurely will thereby have a shorter period of care coordination participation, we compared low birth weight rates between these groups for full-term births (at least 37 weeks gestation). As another way to control for this gestational age bias, we examined birth outcomes by length of maternity care coordination participation in weeks as a *percent* of length of gestation in weeks (less than 25%, 26 to 50%, and more than 50%).

Previous studies have shown that prenatal care provided in public health clinics is very effective in reducing adverse birth outcomes among women in poverty.[4,5] Therefore, it might be argued that women receiving maternity care coordination would have had better birth outcomes simply because most of them received prenatal care in public health departments, particularly in the first years of the program; whereas many of the women not receiving maternity care coordination received their prenatal care from another provider. To control for this potential source-of-prenatal-care bias, we broke out the basic results of this study separately for public health department patients and for patients of other prenatal care providers. We also used source of prenatal care as a control variable in the logistic regression analysis.

Results

Measures in the top part of Table 1 reveal that, among women on Medicaid not receiving maternity care coordination services, the low birth weight rate was 21% higher, the very low birth weight rate was 62% higher, and the infant mortality rate was 23% higher than among women on Medicaid who did receive such services. Further, the average cost of medical care for the baby in the first 60 days of life was $277 higher for infants of women not receiving maternity care coordination services, while prenatal WIC participation was substantially lower for this group.

The results in Table 1 are also shown separately for women receiving prenatal clinic care in public health departments and for those receiving prenatal care from other providers. These results are similar to those for the total: the women receiving maternity care coordination had consistently better outcomes in both prenatal care groups. Therefore, the better birth outcomes for women receiving maternity care coordination are not just a result of most of them receiving prenatal care in the public health setting.

For the total group of 15 526 women receiving maternity care coordination, Medicaid paid an average of $137 for the care coordination services. Dividing the difference in average newborn costs of $277 by this $137 results in an estimated $2.02 saved by Medicaid in all medical costs for services beginning within 60 days of age for each $1.00 spent on maternity care coordination. An average net savings of $140 ($277−$137) for each of the 15 526 women receiving care coordination trans-

lates into a total estimated savings of $2,174,000 for 1988 to 1989.

Table 2 shows that the women on Medicaid who received maternity care coordination services were at somewhat *higher* risk for several of the maternal characteristics often associated with low birth weight and infant death (characteristics derived from the birth certificates). Therefore, their better birth outcomes shown in Table 1 do not appear to be owing to favorable status on these measured risk factors. This slightly higher demographic risk may be related to the fact that some health departments initially targeted maternity care coordination to teens and other high-risk groups because insufficient resources were available to provide this service to all Medicaid-eligible women. Yet the pregnant women who received maternity care coordination had better birth outcomes despite higher levels of these other risk factors.

Table 3 presents the results of a logistic regression analysis that compared the independent effects of various risk factors on low birth weight and infant mortality. Race, age of mother, and medical risk factors during the pregnancy were the strongest predictors of adverse outcomes. After controlling for all the other risk factors shown in Table 3, including source of prenatal care, women not receiving maternity care coordination services were found to be 1.22 times as likely to have had a birth under 2500 g as women receiving the service, 1.48 times as likely to have had a birth under 1500 g, and 1.20 times as likely to have had an infant death. Both low birth weight odds ratios have 95% confidence intervals with the lower limit above 1.00.

So far in this analysis, maternity care coordination has been treated as present or absent, regardless of the length of care coordination for those receiving the service. In Table 4, the women receiving care coordination are divided into two groups: those beginning care coordination 3 or more months before giving birth and those receiving care coordination for a shorter period of time. For each measure in Table 4, the women who received care coordination longer had better outcomes.

The potential problem of bias due to preterm delivery shortening the length of service participation was addressed in two ways. First, we compared only full-term births. Among full-term births, women with care coordination for 3 or more months had a low birth weight rate of 3.81% compared with a rate of 5.07% for those receiving care coordination for less than 3 months ($P < .001$). Second, we compared birth outcomes by percent of the pregnancy for which maternity care coordination was received. Table 5 shows these results. Women who received maternity care coordination for more than 50% of their pregnancy had substantially lower rates of low birth weight, very low birth weight, and infant mortality. These results are further evidence that maternity care coordination services for pregnant women on Medi-

TABLE 1—Outcome Measures for Singleton Medicaid Live Births by Presence of Maternity Care Coordination: North Carolina, 1988–1989 (Births with No Prenatal Care Are Excluded)

Outcome Measures	Received Care Coordination	Did Not Receive Care Coordination	*P* Value for Difference
Total			
Percent under 2500 g	8.67	10.50	<.0001
Percent under 1500 g	1.23	1.99	<.0001
Infant deaths per 1000 live births	9.9	12.2	.02
Percent on prenatal WIC	90.9	66.8	<.0001
Average amount paid by Medicaid for newborn care beginning within 60 days of age	$1694	$1971	<.0001
Number of births	15 526	34 463	
Prenatal Care at Public Health Department			
Percent under 2500 g	8.61	9.95	.0001
Percent under 1500 g	1.16	1.71	.0001
Infant deaths per 1000 live births	9.7	12.5	.03
Percent on prenatal WIC	92.8	84.6	<.0001
Average amount paid by Medicaid for newborn care beginning within 60 days of age	$1674	$1872	<.0001
Number of births	12 842	14 812	
Prenatal Care Not at Public Health Department			
Percent under 2500 g	8.95	10.91	.001
Percent under 1500 g	1.57	2.21	.02
Infant deaths per 1000 live births	10.8	12.0	.58
Percent on prenatal WIC	81.9	53.4	<.0001
Average amount paid by Medicaid for newborn care beginning within 60 days of age	$1790	$2046	.001
Number of births	2684	19 651	

Note. WIC = (Special Supplemental Food Program for) Women, Infants and Children.

TABLE 2—Percentages of Singleton Medicaid Live Births with Selected Maternal Risk Factors by Presence of Maternity Care Coordination: North Carolina, 1988–1989 (Births with No Prenatal Care Are Excluded)

Risk Factors	Received Care Coordination	Did Not Receive Care Coordination	*P* Value for Difference
Black[a]	60.8	58.1	<.0001
Unmarried	66.4	61.2	<.0001
Under age 18	15.6	13.2	<.0001
Education less than 12 years	48.5	44.2	<.0001
Previous fetal or live-born death	24.1	25.0	.06
Prenatal care less than adequate in quantity[b]	49.8	49.2	.19
Mother smoked	30.4	31.2	.07
Medical risk factors this pregnancy	24.4	24.2	.58

[a]Data shown are actually for births for all races other than White, about 94% of which are Black in North Carolina.
[b]Based on intermediate plus inadequate categories of the Kessner Index of the quantitative adequacy of prenatal care use.[6] Missing values for this and the other variables in Table 2 are less than 1% of the total and are excluded from all calculations.

TABLE 3—Estimated Relative Odds of Low Birth Weight and Infant Death with Presence of Selected Risk Factors (Logistic Regression): 1988–1989 Singleton Medicaid Live Births in North Carolina (Births with No Prenatal Care Are Excluded)

Risk Factors	<2500 g	<1500 g	Infant Death
Black	1.66 (1.78, 1.54)	1.69 (1.99, 1.43)	1.14 (1.39, 0.94)
Unmarried	1.15 (1.23, 1.07)	1.10 (1.30, 0.94)	0.99 (1.20, 0.81)
Under age 18	1.29 (1.42, 1.18)	1.31 (1.63, 1.05)	1.23 (1.59, 0.95)
Education less than 12 years	1.12 (1.20, 1.05)	0.98 (1.14, 0.84)	1.09 (1.31, 0.90)
Previous fetal or live-born death	1.26 (1.35, 1.18)	1.74 (2.01, 1.50)	1.24 (1.50, 1.03)
Prenatal care less than adequate in quantity	1.13 (1.20, 1.06)	0.94 (1.07, 0.81)	1.05 (1.24, 0.88)
Mother smoked	1.73 (1.84, 1.62)	1.17 (1.37, 1.01)	1.22 (1.47, 1.02)
Medical risk factors this pregnancy	2.14 (2.27, 2.01)	2.94 (3.37, 2.56)	1.79 (2.13, 1.50)
Received prenatal care outside public health department	1.12 (1.19, 1.05)	1.33 (1.54, 1.15)	1.02 (1.23, 0.85)
Did not receive care coordination services	1.22 (1.32, 1.14)	1.48 (1.76, 1.24)	1.20 (1.47, 0.98)
Number of observations	49 260	49 260	49 288

Note. The 95% confidence interval limits for the odds ratios are shown in parentheses.

TABLE 4—Outcome Measures for Singleton Medicaid Live Births by Length of Maternity Care Coordination: North Carolina, 1988–1989 (Births with No Prenatal Care Are Excluded)

Outcome Measures	Care Coordination 3 or More Months	Care Coordination Less Than 3 Months	*P* Value for Difference
Percent under 2500 g	6.47	10.53	<.0001
Percent under 1500 g	0.70	1.71	<.0001
Infant deaths per 1000 live births	8.7	11.6	.08
Percent on prenatal WIC	92.3	90.0	<.0001
Average amount paid by Medicaid for newborn care beginning within 60 days of age	$1483	$1879	<.0001
Number of births	7680	7846	

TABLE 5—Outcome Measures for Singleton Medicaid Live Births by Percentage of Pregnancy for Which Maternity Care Coordination Was Received: North Carolina, 1988–1989 (Births with No Prenatal Care Are Excluded)

Outcome Measures	Less Than 26 Pct.	26–50 Pct.	More Than 50 Pct.	*P* Value for Difference (Col. 1 vs Col. 3)
Percent under 2500 g	9.88	8.25	6.44	<.0001
Percent under 1500 g	1.44	1.20	0.72	.001
Infant deaths per 1000 live births	10.1	10.6	8.0	.29
Number of births	6587	4908	4031	

caid in North Carolina are effective in reducing adverse birth outcomes.

Discussion

These results strongly suggest that maternity care coordination did improve the outcomes of live births to women on Medicaid in 1988 and 1989, the first 2 years of the Baby Love Program in North Carolina. The apparently large impact of maternity care coordination on very low birth weight is especially important. Even modest reductions in this relatively rare event can make prevention programs cost-effective, given the very high rates of morbidity and the use of medical care among these infants.

The results by degree of maternity care coordination (Tables 4 and 5) provide additional evidence that care coordination improved birth outcomes among these women in 1988 and 1989. Longer participation was associated with better birth outcomes, even after controlling for potential gestational age bias.

Women who receive maternity care coordination are encouraged to obtain a variety of services for which they may be eligible, such as Aid to Families with Dependent Children, job training, social work, transportation, food stamps, and housing assistance. Many of these services are not directly reimbursable by Medicaid. The maternity care coordinator acts as an advocate, assisting the pregnant woman in navigating a complex service system with often confusing application procedures so that such services may be obtained. The visit schedule is determined by the client's need and may be much more frequent than the minimum required level of one encounter per month.

One example of the impact of this assistance was prenatal WIC participation. We found that those women on Medicaid with maternity care coordination were significantly more likely to receive this important nutritional service than those without it. In addition, data for 1988 and 1989 from the North Carolina Health Services Information System show that, among public health department patients, women receiving maternity care coordination were more likely to have had a postpartum family planning exam (68% vs 39%) and to have had their newborns receiving well baby care (65% vs 25%) and WIC (77% vs 36%) than women not receiving care coordination.

In a study such as this, in which it was not possible to randomize patients into treatment and control groups, there is always the possibility of selection bias. Women who would have had better birth outcomes anyway may have been drawn for various reasons into the maternity care coordination group. Conversely, women who have experienced previous adverse pregnancy outcomes may have been channeled into care coordination because of their high-risk status. We have done our best to statistically control for *measurable* differences between the Medicaid women who received care coordination and those who did not, although full comparability is never possible. All the women on Medicaid giving birth in 1988 and 1989 had family incomes below 100% of the federal poverty level, so this was a relatively homogeneous

group in economic terms. The issue of provider selection is also salient. The maternity care providers who most actively got their patients into care coordination in the program's first years may have been among those with the strongest prenatal care programs. It is important to note, however, that the providers who implemented the service during 1988 and 1989 represented rural and urban counties and different geographic regions of the state.

The results of this study must be placed in the context of an early evaluation of a statewide system for maternity care coordination services. During 1988 and 1989, only 31% of eligible women on Medicaid received maternity care coordination. In addition, many providers were still in a start-up phase, lacking the full resources needed for the program. A goal of the Baby Love Program is to develop the service capacity necessary for providing care coordination to all eligible women. Therefore, further evaluation of maternity care coordination is needed to validate and extend the results of this study.

Low birth weight and infant mortality are serious problems in North Carolina and the United States and result from a variety of social, economic, and health care factors. Prenatal care is one important means of addressing these problems. However, there is growing evidence that, for women living in poverty, simply financing more prenatal medical visits is not enough.[7] Low-income pregnant women must also be supported in their efforts to meet basic needs such as housing, transportation, food, education, and health care. Maternity care coordination can help them meet these needs by ensuring the receipt of both medical and nonmedical services. This study suggests that maternity care coordination can be very effective in reducing low birth weight, infant mortality, and medical care costs among babies born to women in poverty. □

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